

ESA-028-2 Caterpillar- Decatur Illinois

Public Report

Introduction:

The Caterpillar plant in Decatur consists of two main fabrication and assembly buildings, building B and building D. Building D is newer with 3 High Bays used for assembly of large mining equipment. Building B, the larger main assembly area is older with new additions added over the years. Our efforts were focused on building B although we did do a cursory review of building D.

Objective of ESA:

Identify opportunities for reducing fan system energy use. The exhaust fans use a large amount of electricity to move the air, and since this air needs to be preheated in the wintertime, they also cause a tremendous consumption of natural gas, roughly 1 million dollars worth of gas in January alone.

Focus of Assessment:

The focus of the assessment was to identify means to shut off the exhaust fans so that the computer controlled supply fans can reduce the amount of heated supply air to the plant.

Approach for ESA:

Due to the massive scale of the plant and the ventilation system that serves it, we tried to focus our efforts on understanding the system as it serves the frame fabrication area of the building. Frame fab has the most acute indoor air quality problems in the winter due to the ineffectiveness of the existing smoke removal system.

General Observations of Potential Opportunities:

Plant gas and electric usage (rounded to nearest thousand)

	2005	2006
Electric kWh	84,040,000	84,776,000
Electric Cost	3,498,000	3,675,000
\$/kWh	0.042	0.043
Gas therms	4,330,000	4,177,000
Gas cost	3,654,000	3,659,000
\$/therm	0.844	0.876

Near-Term Potential Opportunities:

1. If improvements to the ventilation system cannot be made by next winter, there are some minor changes to the control of the exhaust and supply fans that may help improve the air quality, although it is not immediately obvious that these will have an impact on energy use. When the supply fans are able to maintain a positive pressure in the plant some supply fans are cycled off. Currently some supply fans in the interior of the building away from frame fab are cycled off. I think it would be slightly better to keep the air supply high in the "clean" areas of the plant to produce a wall of air moving into the frame fab and vehicle test areas by shutting off the supply in these areas where pollutants are generated. This will help keep contaminants out of areas where they can settle on clean parts (causing paint defects) and will also assist the system to remove more of the welding smoke from frame fab, by pushing harder on the stagnant smoke.
2. Control Door heaters to shut down when Outside air temperature is above 40 °F. In reviewing the gas bills, there were two warm months where the minimum temperature was 50 °F and 43 °F, where the gas usage was significantly above normal summer use. This is probably due to the door heaters coming on. (We were there on a mild day and saw door heaters running with the doors standing open). Assuming there is similar waste in all 4 swing months, (May, June, September and October) the annual savings of shutting down the door heaters in mild weather is significant. The electric savings will be small in comparison to the gas savings.

Medium-Term Potential Opportunities:

Medium term opportunities would require purchase of additional equipment and/or changes in the system such as addition of recuperative air preheaters and use of energy to substitute current practices of steam use etc. It would be necessary to carry out further engineering and return on investment analysis.

3. Resolve welding smoke issue in frame fabrication area and reduce ventilation loads by 25% or more. Approximately 609,000 cfm of wintertime building exhaust is drawn from this part of the plant. Conservative estimates are that this could be reduced by half if a more effective way of dealing with the welding smoke were employed. Currently, the winter problem is that a thick haze of welding smoke develops in the bottom 10 feet of the plant, due to welding smoke (and grinding operations). The welding smoke rises from the weld, and as it drifts upwards it cools off, and stagnates in a blanket that extends from the floor level to about 10 feet above the floor. Most of the supply air outlets are at the 10 foot elevation (or above), and all of the exhaust air fan inlets are on the underside of the roof, so the current system is largely ineffective at removing this smoke. To try and overcome this problem, there is an incredible amount of air being heated and then sucked directly out of the building, and production staff demand that all fans be run all winter to try and mitigate the problem. Unfortunately, the end result is that the top half of the plant is extremely well ventilated, but down on the floor the problem persists, to the detriment of the people and the product.

Two strategies were identified to remove the welding smoke, both of which would allow for the reduction in ventilation. One is to use the push-pull system employed in European CAT plants, as proposed by Plymo-vent (a European supplier associated with Lincoln Welding) the other would employ more conventional strategies combined with locally designed and supplied equipment. The European supplier has provided references and assurances that the system will work, and will not be noisy. They seem to know what they are talking about and this system seems to be a very viable option for resolving the problem. They intend to filter the air in the bottom 10 feet of the plant at a rate of 4 air changes per hour (ACH) in the work zone and re-circulate the filtered air, which will greatly reduce the need for heated outdoor air. A system for the RS-1 area would cost approximately \$250,000, so we extrapolate that the overall expenditure for systems to serve the entire frame fab area would cost between \$1 and \$2 million.

Another option would be a locally designed and supplied system, as described below:

Winter:

- Provide 6 ACH overall, 3 ACH exhaust, 3 ACH re-circulated filtered air
- Develop some sort of moveable hood with light for use in frame fab area for 1 ACH.
- Large slow wall exhausters remove 2 air changes per hour of transfer air from frame fab in winter
- Use floor intake air fountains to filter air in frame fab area to filter 2 ACH
- 1 ACH floor level exhaust around perimeter of building removes floor level smoke in the wintertime.

Summer

- Provide 10-12 ACH in the occupied zone of the most heat intensive areas of the plant
- Provide 4 ACH in plant overall.

Preliminary estimates of the costs of such system are between \$500,000 and \$1 million, depending on how much of the current system and ductwork can be reconfigured and re-used.

Next steps: A prudent next step would be to do a comprehensive air balance survey of the plant to better quantify the amount of air flow serving the various processes in the plant (frame fabrication, vehicle testing, and painting are the three largest air users). Such a task would involve several person weeks of engineering effort.

4. Resolve ventilation issues in vehicle test area and reduce ventilation loads by 15% or more. Currently about 30% of the exhaust is drawn from the vehicle test area. The system is regarded as inefficient and ineffective. Conservative estimates are that the system could be substantially reduced (at least in the winter) thus reducing the need to provide heated make up air to this portion of the plant.

Long-Term Potential Opportunities:

Long term opportunities would require testing of new technology and confirmation of performance of these technologies under the plant operating conditions with economic justification to meet the corporate investment criteria.

No Long term opportunities were identified.

Management Support and Comments:

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